IJCPS Vol. 9, No. 6 , Nov-Dec 2020 International Journal of Chemical and Physical Sciences
www.ijcps.org (Peer-Reviewed Journal)
DOI Prefix:10.30731/ijcps ISSN:2319-6602

Molecular Interactions in the Solution of Leaf Extract of OcimumTenuiflorum: An Ultrasonic Study

S. S. Aswale[a], S. R. Aswale[b], S. S. Kamble[c], P. J. Ganjare[d]

[a] Department of Chemistry, Lokmanya Tilak Mahavidyalaya, Wani, Maharashtra, India
[b] Department of Chemistry, Mahatma Gandhi College of Science, Gadchandur, Maharashtra, India
[c] Department of Chemistry, Arts, Commerce and Science College, Maregaon, Maharashtra, India
[d] Department of Chemistry, Shivramji Moghe College, Pandharkawada, Maharashtra, India

***Corresponding Author E-Mail:** kambleshailesh20@gmail.com

Received: 07.11.2020 **Accepted: 10.12.2020** **Published Online 15.12.2020**

Abstract

Ultrasonic Velocity, density, viscosity have been measured experimentally for the solution of leaf extract of OcimumTenuiflorum in double distilled water with various concentrations at 298.15 K, 303.15 K, 308.15 K keeping constant frequency of 2 MH_Z As the acoustical parameters like adiabatic compressibility, intermolecular free length, relative association, relaxation time , specific acoustic impedence would prove to be more useful to predict and confirm the molecular interactions, these have been determined by measuring the Ultrasonic Velocity, density, viscosity of the prepared solution. A variation in these parameters will provide strong information regarding the molecular interactions taking place in the solution.

Keywords: Ultrasonic Velocity, Adiabatic Compressibility, Relative Association.

Introduction:

In recent years ultrasonic technique has become a powerful tool in providing information regarding the molecular behaviour of the liquids, polymer solutions and mixtures etc. Owing to its ability of characterizing physico-chemical behavior of the medium. Ultrasonic velocity measurements and other acoustic parameters of liquid mixtures are the powerful technique in understanding of chemical nature and the molecular interactions. Our country is very well known for Ayurveda, in the Ayurveda medicines are largely made up from plants, herbs. One of such herbs is Tulsi which is also known as Holy Basil. Tulsi is known for its antifungal nature. The solution of leaf extract of *OcimumTenuiflorum*in distilled water is studied at 2 MHz for the concentration of 1%, 0.5%, 0.25%, 0.125% at 298.15K, 303.15K, 308.15K. Here the effect of concentration at different temperature on molecular interaction will be predicted which may be helpful for predicting the reactivity of the extract.

Experimental:

The leaf extract used in this study was of analytical range. Double distilled water was used for the preparation of solution. A special thermostatic water bath arrangement was made to maintain constant temperature. 1%, 0.5%, 0.25%, 0.125% solutions of leaf extracts of *ocimum tenuiflorum* was prepared by taking accurate weights on electronic digital balance (Model CB/CA/CT-Series, Contech having accuracy ± 0.0001 g.) The ultrasonicvelocity of the 1%, 0.5%, 0.25%, 0.125% solutions of leaf extracts of ocimum tenuiflorum was measured with the Multifrequency ultrasonic interferometer (Model M-83, Mittal Enterprizes) at 2mhz with an accuracy of $\pm$ 2 m/s. All the readings were

taken at 298.15 K, 303.15K, 308.15K.The viscosity was measured by using Ostwald's viscometer and the density of the solution was measured by using Digital densitometer (DMA-35, Anton paar).

Computations:

By using ultrasonic velocity following ultrasonic parameters are calculated.

Adiabatic compressibility -

$$\beta=1/v^2d$$

Where, v - Velocity of solution,

d - Density of liquid

Intermolecular free length -

$$L_f = K\sqrt{\beta_s}$$

Where, K - temperature dependent known as Jacobson's constant

Specific acoustic impedance -

$$Z = v \times d_s$$

Relative association -

$$R_A = d_s / d_0 [v_0 / v_s]^{1/3}$$

Where, v_0 - Ultrasonic velocity of solvent

v_s - Ultrasonic velocity of solution

Relaxation time -

$$\tau = 4/3\ \beta_s \times \eta$$

Results and Discussion:

The ultrasonic velocity of 1%, 0.5%, 0.25%, 0.125% OcimumTenuiflorum (Tulsi) leaf extract solution in water was measured at 298.15 K, 303.15K, 308.15K at 2 MHz frequency. From table no.1, it is observed that at different concentrations the ultrasonic velocity increases with increase in concentration, but this increase is not regular as we can see from the Table no.1 and figure no 1. Figure 2 shows the variation of viscosity with temperature at different concentrations.

From table no.2 and fig.3 it is observed that adiabatic compressibility decreases with increase in concentration. This can be explained as the water molecules strongly associate through hydrogen bonding with leaf extract molecules. Therefore bonds between solute- solvent strengthen the intermolecular forces resulting in decrease in adiabatic compressibility with increase in concentration. A strong evidence for solute - solvent interaction is that the value of specific acoustic impedance increases with increase in concentration in figure 4. The intermolecular free length is the distance between the surfaces of the neighbouring molecules. Here the intermolecular free length decreases with increase in concentration which clearly indicates stronge solute- solvent interaction figure 5.

Relative association is a measure of extent of association of components in the medium. It is a property of understanding the molecular interaction in liquid mixtures and solutions. As discussed relative association depends on either of breaking of solvent molecules on addition of solute to it or the

salvation of ions that are present. The result shows that relaxation time and relative association increase with increase in concentration at a given temperature (fig.6 & fig.7).
The experimentally determined values are listed in the following table.

Table 1: Density, Viscosity and Velocity (at frequency 2 MHz) of Tulsi leaf extract solution,

Conc. (%)	Temp. (K)	Density (d_s) (Kg m^{-3})	Velocity(v_s) (m/s)	Viscosity (η) (Kg $m^{-1}s^{-2}$)
1%	298.15	1000	1494.2	9.163 E^{-4}
	303.15	999.2	1352.4	7.018 E^{-4}
	308.15	999.0	1369.2	7.950 E^{-4}
0.5%	298.15	998.6	1424.4	9.218 E^{-4}
	303.15	998.3	1380.0	6.375 E^{-4}
	308.15	998.0	1439.8	8.317 E^{-4}
0.25%	298.15	998.0	1396.8	8.7368 E^{-4}
	303.15	995.9	1400.8	6.875 E^{-4}
	308.15	995.1	1404.0	7.890 E^{-4}
0.125%	298.15	997.9	1448.0	7.974 E^{-4}
	303.15	996.4	1495.0	6.412 E^{-4}
	308.15	994.5	1553.2	7.091 E^{-4}

Table 2: Acoustic parameters of Tulsi leaf extract solution in distilled water at 2 MHz.

Conc. (%)	Temp. (K)	Adiabatic Compressibiliy	SpecificAcoustic Impedence Kg M^{-2} S^{-1}	Intermolecular free length	Relative Association	Relaxation time
1%	298.15	4.480 E^{-10}	1494200	4.331 E^{-11}	2.758 E^{-1}	5.473 E^{-13}
	303.15	5.471 E^{-10}	1351318	4.842 E^{-11}	4.169 E^{-1}	5.107 E^{-13}
	308.15	5.350 E^{-10}	1365092	4.844 E^{-11}	3.707 E^{-1}	5.657 E^{-13}
0.5%	298.15	4.935 E^{-10}	1422405	4.560E^{-11}	2.890 E^{-1}	6.050 E^{-13}
	303.15	5.261 E^{-10}	1377240	4.563 E^{-11}	4.081 E^{-1}	4.460 E^{-13}
	308.15	4.832 E^{-10}	1438792	4.604 E^{-11}	3.530 E^{-1}	5.345 E^{-13}
0.25%	298.15	5.135 E^{-10}	1394006	4.6611E^{-11}	2.946 E^{-1}	5.998 E^{-13}
	303.15	4.918 E^{-10}	1377240	4.603 E^{-11}	3.933 E^{-1}	4.497 E^{-13}
	308.15	5.097 E^{-10}	1397120	4.728 E^{-11}	3.608 E^{-1}	5.172 E^{-13}
0.125%	298.15	4.786 E^{-10}	1443961	4.4996E^{-11}	2.841 E^{-1}	5.075 E^{-13}
	303.15	4.490 E^{-10}	1489618	4.3981 E^{-11}	3.761 E^{-1}	3.829 E^{-13}
	308.15	4.169 E^{-10}	1544458	4.2760 E^{-11}	3.206 E^{-1}	3.931 E^{-13}

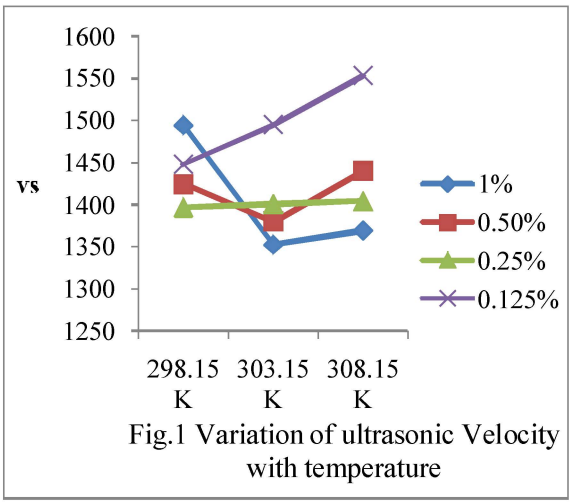

Fig.1 Variation of ultrasonic Velocity with temperature

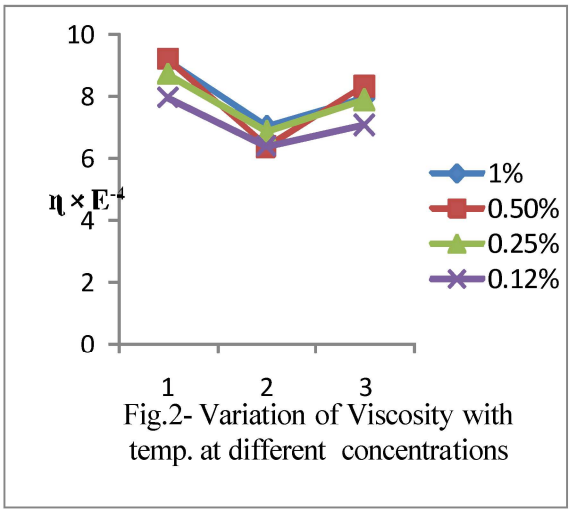

Fig.2- Variation of Viscosity with temp. at different concentrations

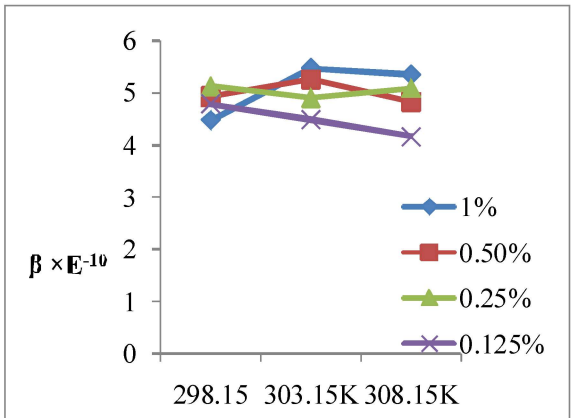

Fig.3-Variation of Adiabatic compressibility with temp. at diff. conc.

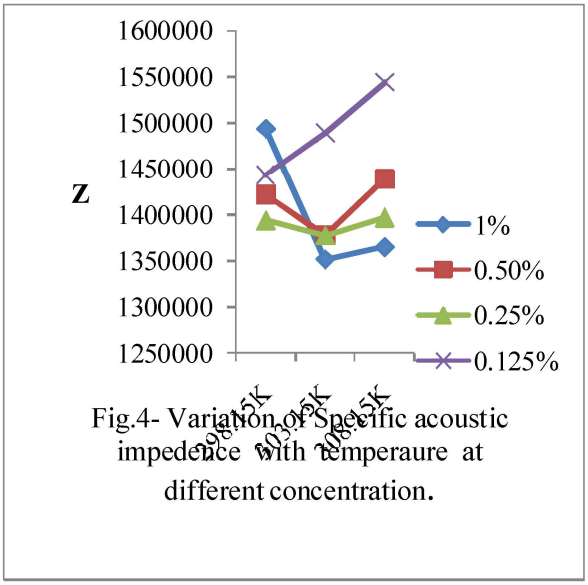

Fig.4- Variation of Specific acoustic impedance with temperaure at different concentration.

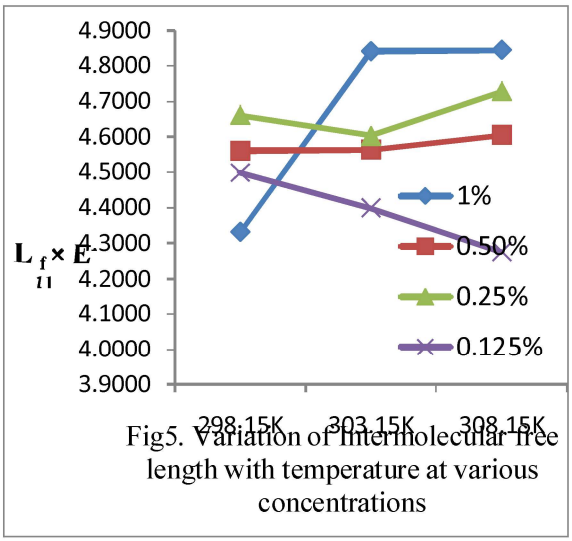

Fig5. Variation of Intermolecular free length with temperature at various concentrations

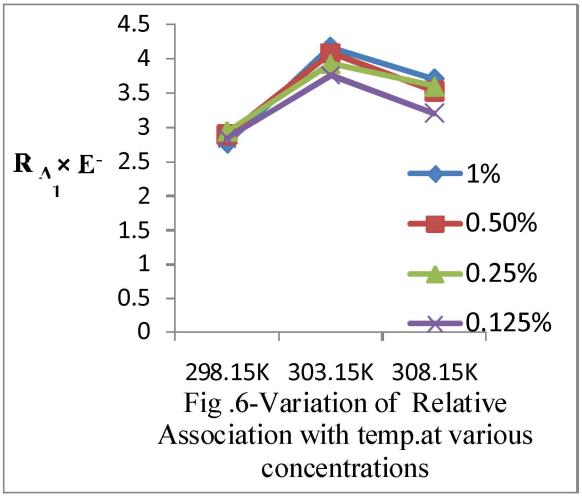

Fig .6-Variation of Relative Association with temp.at various concentrations

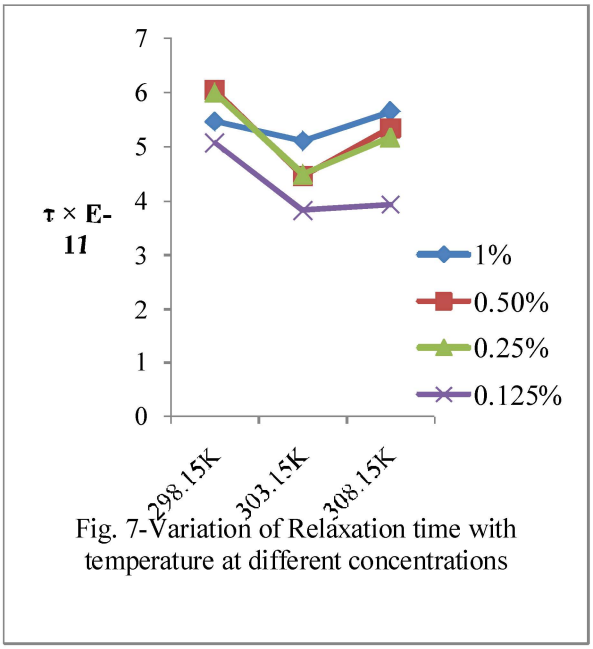

Fig. 7-Variation of Relaxation time with temperature at different concentrations

Conclusion:

From the above discussion, nonlinear variation with temperature in adiabatic compressibility (βs), acoustic impedance (Z), free length (Lf), relaxation time (ι), relative association (RA), is observed in the system. It shows the presence of hydrogen bonding between the –OH groups of solute and –H or –O- of solvent molecule. It is observed that molecular association between Tulsi leaf extract and water solvent may arise from intermolecular hydrogen bonding which supports the molecular association occurring in the solution.

References:

[1] P.J. Ganjare, S.S. Aswale, S.R. Aswale, "Molecular interactions in the solutions of sodium salt of 4- amino-2-hydroxy benzoic acid", World Journal of pharmaceutical Research, Vol.6, Issue 1, 564- 573, 2016.

[2] Dhote A.B, Aswale S.S, Aswale S.R, "Comparative study of dichlofenac sodium and (paracetamol + dichlofenac sodium) ultrasonically at 303.15k", International Research Journal of Science and Engineering, special issue A7, pp864-868, 2020.

[3] P.J. Ganjare, S.R. Aswale, S.S. Aswale, "Prediction of molecular interactions in liquids from density, viscosity, and conductance measurements", Vidyabharti International interdisciplinary Research Journal, special issue may 2020.

[4] R.R.Tayde, A.S.Chandami and M.P.Wadekar, "Ultrasonic investigation and molecular interactions studies in substituted oxoimidazoline drugs solutions at different concentrations", Journal of chemical and Pharmaceutical Research, 6(9), 114-121, 2014.

[5] K. Rathina, M. Umadevi, C.Senthamilselvi, RamalathaMarimuthu, "Research on solvent ion interactions in the inorganic liquid mixtures by ultrasonic technique", International journal of Engineering and Advanced technology, 8, 151-159, 2019.

[6] S.R. Aswale,S.S.Aswale,V.N.Gowardipe, "Variation of acoustic parameters of herbal extract pomegranate solutions at frequency 4 mhz", International journal of chemical and physical sciences, Vol.4, Special Issue, pp 308-312, 2015.
[7] R.S. Hajare, S.S. Aswale, S.R. Aswale, "Relative association , specific acoustic impedence and free volume of antibiotic cefotaxime sodium", International journal of current engineering and scientific research, Vol.6, issue -1, pp 332-337, 2019.
[8] A.B.Dhote, S.R. Aswale, S.S.Aswale, "Ultrasonicstudies of molecular interactions in the solution of anti-pyrrtic drug at 6 mhzand 303.15K", Gurukul international Multidisiplinary Research Journal, pp103-105, 2016.
[9] Z. D. Draelos - 2003A, Cosmetics Dermatol - 16 (9), pp46-49, 2003.
[10] Z. D. Draelos- 2003B, Cosmetics Dermatol-16 (10),pp 41-42,2003.